The Dunsborough implement: an Aboriginal biface from southwestern Australia

by J. E. Glover, C. E. Dortch and B. E. Balme

Geology Department, University of Western Australia, Nedlands, W.A. 6009
Western Australian Museum, Francis Street, Perth, W.A. 6000
Geology Department, University of Western Australia, Nedlands, W.A. 6009

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Abstract

A chert artifact superficially resembling a Palaeolithic biface has been found at Dunsborough, Western Australia. It is distinctively coloured, but otherwise resembles petrographically the Aboriginal artifacts of Eocene bryozoan chert previously described from southwestern Australia. The presence of *Nothofagidites* sp. and *Haloragacidites harrisii* (Couper) Harris, rules out European origin. Other microfossils indicate Early or Middle Eocene age for the chert. The Dunsborough implement, and another biface from a nearby site, are made of rock probably quarried west of the present Western Australian coast in the late Pleistocene or early Holocene, when sea level was lower. The investigation emphasizes the potential value of palynological examination of chert implements particularly when exotic origin is suspected.

Introduction

Over the past half century, numerous large bifacially flaked stone implements have been found in Australia, particularly at sites in the coastal districts of southeastern South Australia and western Victoria (Fig. 1). Most are of Aboriginal origin, but several are European, the best known being Palaeolithic implements picked out of English flint ballast dumped by sailing ships at Port Lincoln, South Australia (Fig. 1). The latter implements are displayed at the South Australian Museum.

The most controversial of these bifacially flaked pieces is the Scaddan implement (Fig. 2), a flint biface closely resembling an Acheulian hand axe, which was collected at Scaddan near the south coast of Western Australia (Fig. 1). The specimen was early recognised as problematical (Noone 1943), though Tindale regarded it as an Aboriginal artifact (Tindale 1941, p. 145; 1949, p. 165). A decade later McCarthy stated that the Scaddan implement resembled "more closely the flint *coup-de-poing* from Europe, examples of which, brought here by various people or in ships' ballast, have found their way into strange places in Australia." (McCarthy 1958, p. 178).

In 1976 two of us (CED, JEG) carried out an archaeological and petrological study of the Scaddan implement (Dortch & Glover in press) and concluded from its technology and style, its stone texture, surface patination and colour, and its rolled condition, that it is much more likely to be of English than Australian origin. Unfortunately the contained microfossils were poorly preserved, and gave no conclusive information about the origin and age of the stone.

Soon after the analysis of the Scaddan implement, another large flint or chert biface somewhat resembling a Palaeolithic hand axe was found by a schoolboy, Clayton Wholley, at the small coastal resort of Dunsborough some 200 km south of Perth (Fig. 1). The implement was in a vacant block of land from which the vegetation had been partly cleared in preparation for building. When first seen it was partly exposed in the surface of a sandy deposit which has been extensively disturbed during the European era.

Now, artifacts of Middle or Late Eocene chert are of particular interest in the prehistory of the Perth Basin and adjacent areas. They characterize late Pleistocene and early Holocene assemblages, but their source has never been found because it was probably submerged about 6000 BP (Glover 1975). Consequently the presence or absence of these artifacts in an assemblage provides archaeologists with a pointer to its age.

There are therefore several reasons for reporting on the Dunsborough implement in detail, and establishing the age of the chert. This paper gives an archaeological description of the Dunsborough implement, describes its petrology and palynology, and discusses its history and its relationship to other Western Australian chert artifacts. In particular, the investigation shows how palynological techniques may illuminate the origin of chert implements, and how they can distinguish transported Acheulian hand axes from Australian implements of similar appearance. The responsibilities of the authors are as follows: archaeology, CED; petrology, JEG; palynology, BEB.

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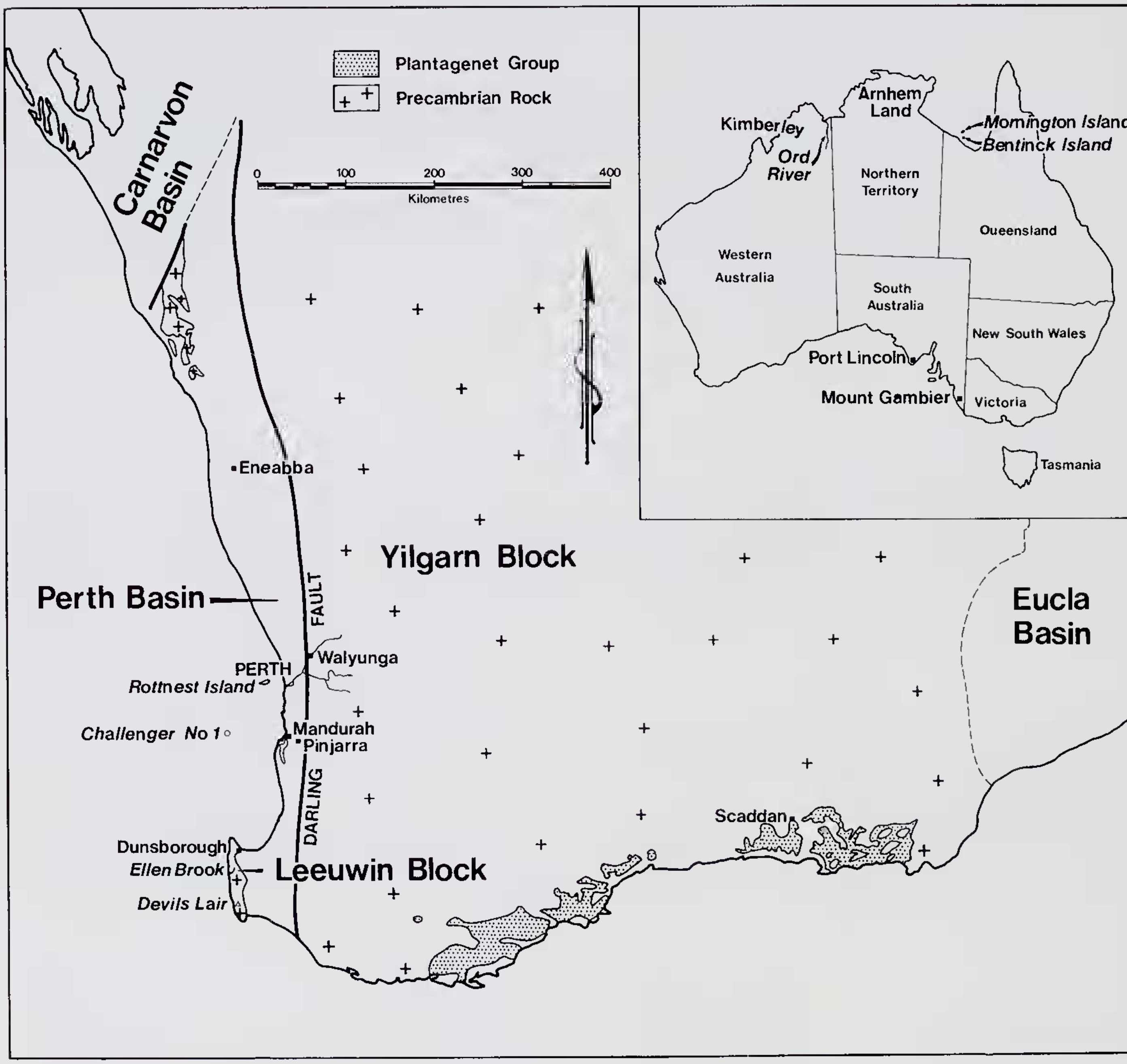

Figure 1.—Map showing localities mentioned in the text.

Archaeological description

The Dunsborough implement (Fig. 3) is a complete, invasively flaked chert biface. It weighs approximately 300 g and has the following dimensions: length 106 mm; width 83 mm; and thickness 46 mm. In plan view or outline the piece is sub-oval, and it is roughly elliptical in section. About one third of one face (Fig. 3, right) retains a cortex surface. A single positive conchoidal fracture extends over much of the opposing face (Fig. 3, left) and so the implement is probably made on a single large flake. The right-hand and lower edges of the piece (Fig. 3, right) are broad and thick with deeply biting, bold flake scars, whereas the left-hand and upper left edges shown in the same figure have much more acutely angled edges produced by shallower and more invasive bifacial flaking. (The latter angles are not apparent in the side view shown in Fig. 3, centre.)

The piece shows very clear abrading and crushing, i.e. multiple, overlapping and very small (0.5-5 mm) conchoidal fractures, on parts of its lateral edges and particularly on the low ridge running down the lower centre of the face shown in Figure 3, right. The crushing on this ridge encroaches over the adjacent flake scar ridges and facets, clearly post-dating them. Most of the other flake scar ridges on both faces are undamaged or only very slightly so. The two fan-shaped scars extending left of the abraded ridge in Figure 3 right, and also several much smaller scars immediately to the right of the ridge, seem to originate from a single source of percussion. Possibly then this face was used as an anvil or hammer surface; on the other hand these scars could be the result of glancing percussion occurring when the piece lay with its face exposed to stones carried in high-velocity water flow. The proximity of these flake scars to the abraded central ridge, the virtual absence of abrading or battering on the opposite face of the piece (Fig. 3, left), and its differentially abraded lateral edges, all suggest that they are the result of use, or perhaps a combination of use and some natural abrasion.

The fragmentary remains of the calcareous shell of a marine invertebrate adhere to one face (Fig. 3, right, lower right corner). As the shell is of recent origin the implement must have been submerged only a short time before being found and so the piece was not in primary position when collected.

Stylistically the Dunsborough implement does not closely resemble any of the classic forms of Acheulian or Mousterian hand axes from north-western Europe (cf. Bordes 1961; Roe 1968; Wymer 1968). However its surface colouration and texture, size, and general morphology place it within the range of biface variation known from European Palaeolithic assemblages.

Petrology

The surface colour of the implement ranges from medium bluish grey (5B5/1) to greenish grey (5GY6/1) and yellowish grey (5Y7/2) (See Rock-color Chart Committee 1963 for comparative colours, and explanation of the symbols). A section through the implement shows that it is rimmed locally by a bluish white (5B9/1) patina up to 2 mm thick. Inward from the patina, the core ranges from medium grey (N5) to very light grey (N8), and there is a small, light brown (5YR6/4) area about 1 cm long stained by iron oxide.

The rock is a fossiliferous chert with abundant silicified Bryozoa and Foraminifera, in a matrix of cryptocrystalline silica (average grain size <0.01 mm in diameter). There are numerous patches of coarser chalcedonic quartz (average grain diameter 0.03 mm), and some tests have an infilling of coarse, drusy chalcedony with a core of granular quartz. Siliceous spicules are also present, but their original composition is uncertain.

A feature of many of the silicified tests is a very fine fringe, generally directed inward from the test wall. The fringe is formed of colourless, roughly wedge-shaped bodies, commonly about 0.01 mm long, with a pronounced nega-

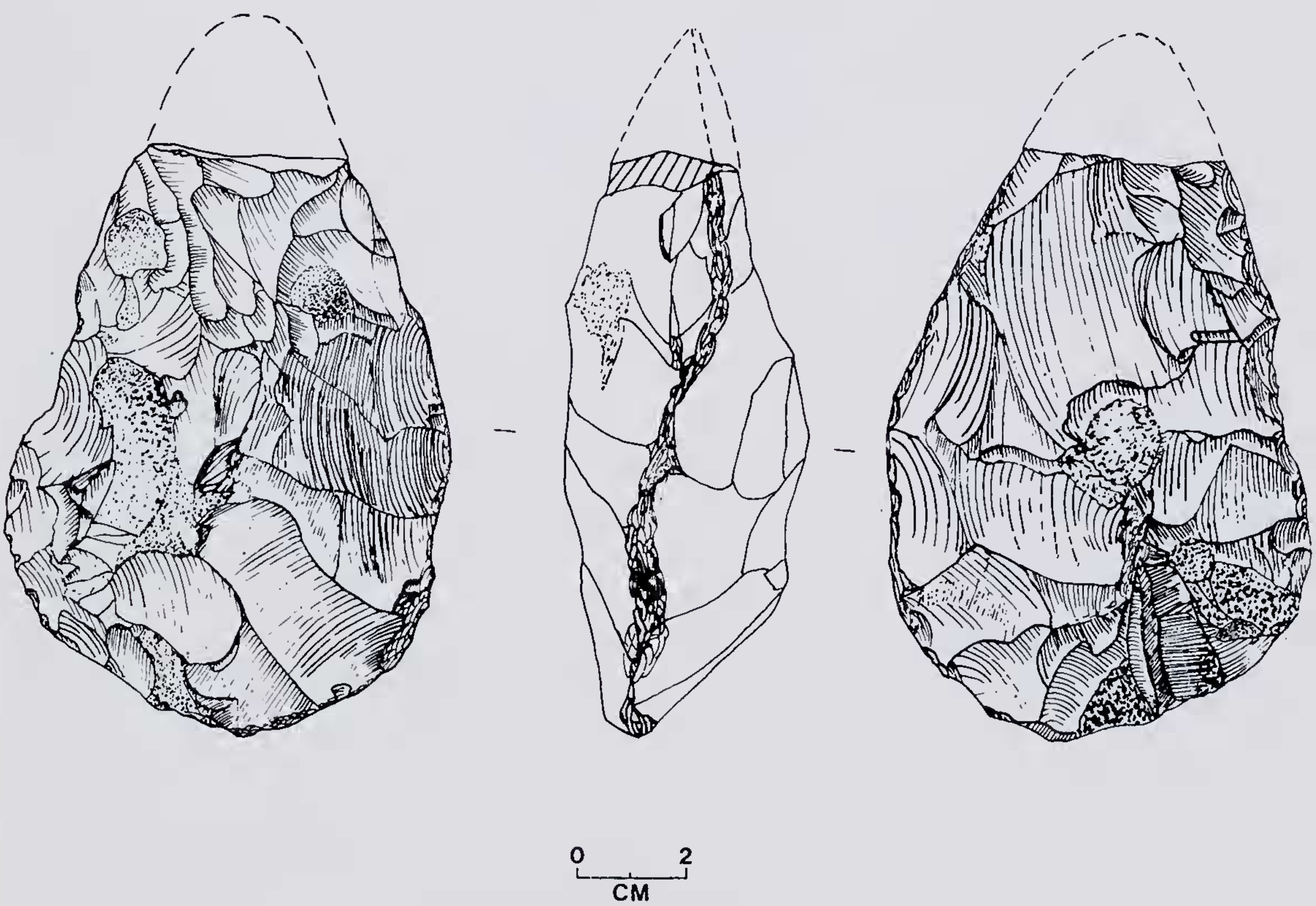

Figure 2.—The Scaddan implement.

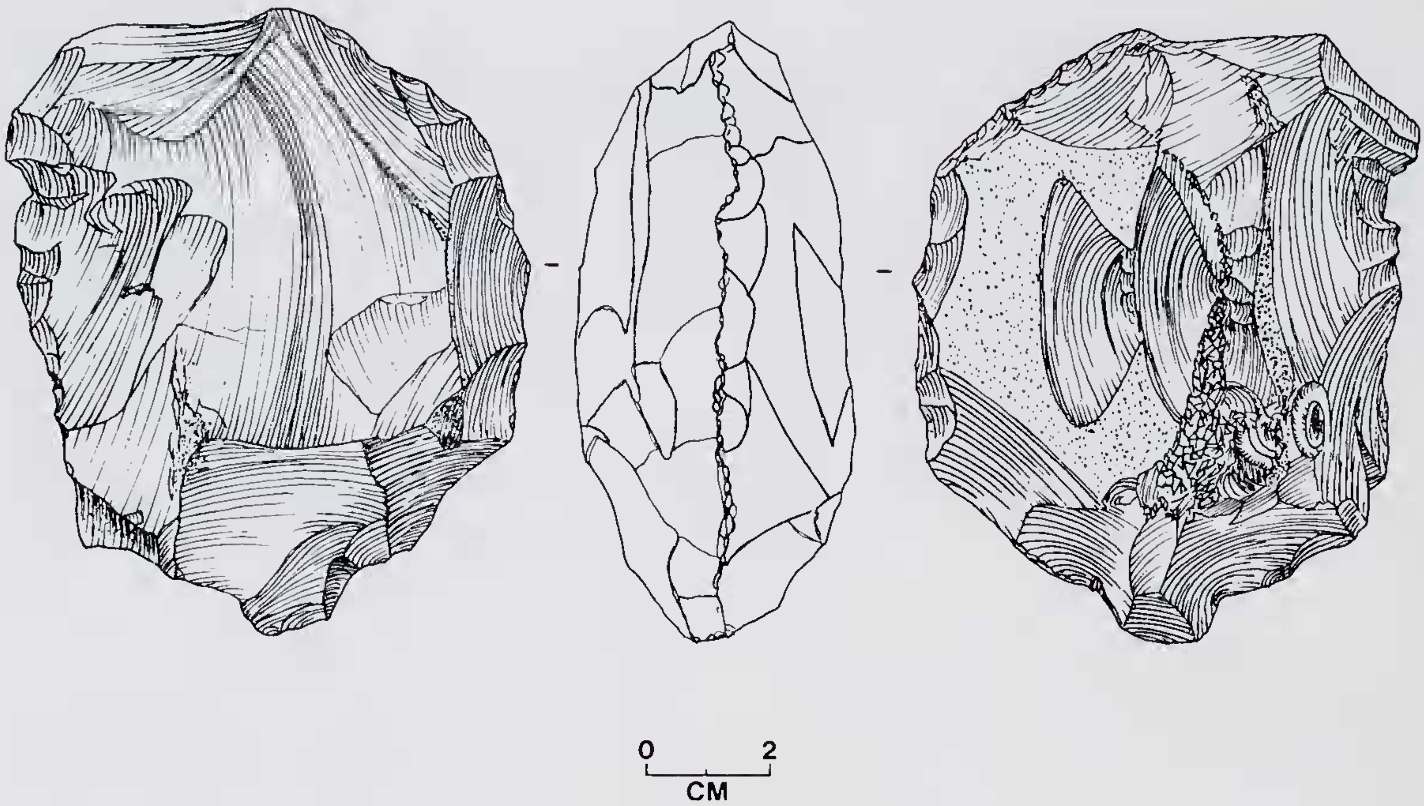

Figure 3.—The Dunsborough implement.

tive relief that causes them to appear dark under low magnification. The bodies were first thought to be opal, but their negative relief is too strong. Their drusy habit suggests that they are cavities left after solution of drusy calcite that was not replaced by silica. Whatever their origin, these features are common in Western Australian Eocene chert.

Other material in the chert includes rare glauconite pellets, silt-sized clastic quartz, grey, finely disseminated clay, and fragments of plant microfossils.

Comparison with chert flakes

The Dunsborough implement was found in an area from which flakes of chert, quartzite, mylonitic rock and silcrete were recovered. Quartzite is quite abundant. A broken pebble of granitic rock was also collected.

Chert flakes are common in the Perth Basin, particularly in the western part of a belt extending between Eneabba and Mandurah (Glover 1975). Many of these flakes contain Eocene Bryozoa, and the Middle and Late Eocene foraminifer *Maslinella chapmani* Glaessner and Wade has been identified in two of them (Glover & Cockbain 1971). More recently, concentrations of similar flakes have been found in blow-outs in sand on the western part of the Leeuwin Block. Petrologically, there is nothing to distinguish the chert flakes found at Dunsborough, or elsewhere in the Perth Basin or Leeuwin Block, from the chert of the implement. There is, however, a difference in surface colour. Most of the flakes in the Perth Basin range from white, through shades of grey, brown and orange, whereas the implement has blue and green tints noted elsewhere only in two of the Dunsborough flakes. The significance of these colours is uncertain, because the colour of many flakes seems to be at least partly influenced by the colouration of the sand in which they are found.

Palynology

Treatment

Inorganic and oxidisable organic materials were removed by boiling about 2 g of the crushed chert in HF, followed by warming the residue in 10% HCl and oxidising the acid-insoluble fraction with concentrated HNO_3. A small quantity of microscopic plant fragments remained. Because the number of identifiable plant microfossils in the final residue was small, three separate preparations were carried out to guard against misinterpretations resulting from laboratory contamination.

Plant microfossils

Plant microfossils were recovered from each of the three preparations. Small cuticular pieces and woody tissues predominated, but fragmental dinoflagellates of the *Spiniferites*-type were fairly common. No more than about 10 identifiable microfossils were found in each of the residues. However, the assemblages were consistent and the same forms were recognised in all three. It was therefore concluded that the plant microfossils were derived entirely from the material of the biface. All the species identified are listed below:

Spores and pollen:
- *Cyathidites* sp.
- *Haloragacidites harrisii* (Couper) Harris
- *Nothofagidites* sp. (*Nothofagus brassii*-Group)

Microplankton:
- *Leiosphaeridia* sp.
- *Veryhachium* sp.
- *Homotryblium floripes* (Deflandre & Cookson) Stover
- *Spiniferites* sp.
- *Deflandrea* sp. (hypotract only)
- *Rottnestia borussica* (Eisenack) Cookson & Eisenack
- *Wetzeliella* sp. cf. *W. lineidentata* Cookson & Eisenack
- *Leptodinium maculatum* Cookson & Eisenack.
- *?Schematophora* sp.
- *Baltisphaeridium paucifurcatum* (Cookson & Eisenack) Downie & Sarjeant

Reworked microfossils:
- *Microbaculispora tentula* Tiwari (Permian)
- *Plicatipollenites* sp. (Lower Permian)
- *Cycadopites cymbatus* (Balme & Hennelly) Segroves (Lower Permian)

The presence of *Nothofagidites* sp. and *Haloragacidites harrisii* rule out any possibility that the chert is European. Both these species are typically southern hemisphere forms that range from the Late Cretaceous to the present. In Western Australia they are frequently associated in Eocene assemblages and in this State *Nothofagidites* has not yet been recorded from sediments older than Eocene.

Wetzeliella is unknown from pre-Tertiary strata. Its first appearance is in the Early Palaeocene of North America and its latest occurrence in the Middle Miocene of Europe (Harker & Sarjeant 1975). In Australia it particularly characterises Eocene sediments. Stover (1975) discussed the stratigraphic distribution of *Homotryblium floripes* which was recorded by Cookson and Eisenack (1961) from the Kings Park Formation, between 451 and 486 m in the Rottnest Island bore. Current opinion regards this section of the Kings Park Formation as Early Eocene (Cockbain & Ingram quoted by Quilty 1974). According to Stover, the species ranges into the Early Miocene. The type material of *Leptodinium maculatum* Cookson & Eisenack also came from the interval 453-486 m in the Rottnest Island bore. This is the only published record from Australia, although a similar form occurs in the Lower and Middle Eocene of Europe.

The other dinoflagellates present are all consistent with an Early Tertiary age, although they are less important, either because they are long-ranging forms, or because the identifications are uncertain.

Considering the sum of evidence, the most likely age of the assemblage is Early or Middle Eocene. Comparisons with published data from Australia further strengthen this conclusion. In particular, there are striking similarities between the microfossil assemblage from the biface and those recovered from sediments in the interval 453-485 m in the Rottnest Island bore (Cookson & Eisenack 1961; Hassell & Kneebone 1960). All the plant microfossils listed, or closely similar forms, have been previously recorded from samples in this interval, with the exception of reworked Permian microfossils. As an additional check, material from the Rottnest Island bore, prepared by Dr C. W. Hassell and retained in the collections of the Department of Geology, University of Western Australia, was re-examined. Rare Permian saccate pollen grains and a specimen of *Microbaculispora tentula* Tiwari were found in a smear mount prepared from a core cut in the interval 451-470 m. The source of these reworked Permian pollen grains is obscure. No exposures or shallow subsurface occurrence of Permian strata are known in the vicinity of Rottnest Island. As reworked Cretaceous pollen are also present in the Tertiary assemblages, it is possible that the Permian forms represent second-cycle reworking, from Mesozoic sediments.

In summary, the palynological evidence points irresistibly to the conclusion that the biface is made of Early or Middle Eocene chert, obtained either from the Kings Park Formation or a unit correlating with it.

Stratigraphic source of the chert

The source of the Dunsborough implement, and of petrographically similar chert pieces, is bound up with the distribution of Eocene rocks in the southwest of Western Australia. There is only one sequence of Eocene rocks cropping out in the region, namely the Late Eocene Plantagenet Group, which is distributed within an irregular belt along the south coast, and is a local source of chert for artifacts. Colloform opal is common in chert flakes from the Plantagenet Group, but is absent from flakes on the Leeuwin Block, and in the central and northern Perth Basin.

The only unit described from the Perth Basin that contains Eocene rocks is the sub-surface, Palaeocene—Early Eocene Kings Park Formation (Quilty 1974). However, palynological evidence suggests that the interval from this formation intersected between 451 and 486 m in the Rottnest Island bore extends to the Middle Eocene. In addition, Quilty (pers. comm. 1975) has recognized unnamed Late Eocene strata, including chert, from the interval between 510 and 590 m in WAPET's Challenger No. 1 well, about 60 km west of Mandurah. There are clearly gaps in our understanding of the Eocene stratigraphy of the Perth Basin, and published information is far from comprehensive.

The chert of flakes from the Perth Basin has been dated as Middle or Late Eocene from Bryozoa and Foraminifera. It has been argued that the concentrations of Perth Basin chert flakes in the Eneabba-Mandurah belt, and their increase in frequency westward, point to derivation from westward sources that were submerged as the sea rose to its present level (Glover 1975). More recently, indendent radiocarbon evidence from excavations at Walyunga shows that the source of chert for artifacts was eliminated between 6135±160 and 3220±100 years ago (Pearce, pers. comm. 1976). Recent work has also revealed additional concentrations of chert flakes near the western margin of the Leeuwin Block, and it can be argued that those also come from the west.

The flora of the Dunsborough implement correlates well with that of the Early or Middle Eocene rocks in the interval of Kings Park Formation between 451 and 486 m in the Rottnest Island bore. As these rocks do not crop out, the source of the implement is best sought seaward. Rocks of the Kings Park Formation would have been exposed in the valley of the ancestral Swan, and probably elsewhere in windows through the veneer of later rocks. The Kings Park Formation lenses out around the latitude of Pinjarra, and off-shore rocks of equivalent age in the Dunsborough region may have yielded the implement.

Unfortunately, the chert flakes assumed from the Bryozoa and Foraminifera to be Middle or Late Eocene, have not yielded palynological residues sufficiently well preserved to compare with the residues from the Dunsborough implement. The various flakes and the Dunsborough implement may therefore have come from rocks of the same age, or of somewhat different age and stratigraphic position within the Eocene Series.

Discussion

The best documented concentration of large, invasively flaked flint bifaces on the Australian continent is in the assemblages noted earlier from sites in southeastern South Australia and western Victoria. Tindale (1941) designated these assemblages as the "Gambieran" industry, because there is a concentration of them near Mt Gambier, South Australia. Illustrations of selected specimens of flint bifaces from this district (Mitchell 1949, Figs. 32, 33; Stapleton 1945, Figs. 1, 10, 11) clearly show them to be remarkably similar to Old World Palaeolithic hand axes, a fact noted by the two foregoing and other authors (McCarthy 1940, p. 30-33; Mulvaney 1961, p. 71-72; Tindale 1941, p. 145, 165.).

The regional stone industries of Kimberley and Arnhem Land also contain a series of bifacially flaked points and axes in which there are a few pieces resembling Lower or Middle Palaeolithic bifaces. Dortch & Glover (in press) illustrate an ethnographic example of one of these from the Ord valley in east Kimberley. Other large bifaces were collected by the late E. J. Brandl in Arnhem land.

The large picks or "oyster stones" from Bentinck and Mornington Islands, Queensland (Fig. 1), which Tindale (1949, p. 161) describes as being "of crude biface form", in some cases at least are square or rounded in section (Tindale 1949, Figs 6, 11) and so are not truly bifacial. We agree with McCarthy (1958, p. 178-9) that these pieces do not resemble the developed "hand axe" or *coup-de-poing* of the Old World Palaeolithic. Instead they seem to be similar to the more crudely flaked specimens of the *biface abbevillien* and the *pic* of the Lower Palaeolithic of France (cf. Bordes 1961, Plates 88, 90, 91).

Large bifaces, generally of edge-ground form, are known from sites in many parts of Australia (McCarthy, Bramell & Noone 1946, p. 15, 49), including the southwest (Akerman 1973; Ride 1958). However, apart from the "Gambieran" concentration and the few specimens from Kimberley and Arnhem Land, there do not seem to be any other clear regional series of large bifaces resembling those of the Old World Palaeolithic.

Nevertheless the Dunsborough implement is not the only unequivocally indigenous, large biface from the southwest. In October 1976 one of us (CED) recovered a broken chert biface from a coastal blow-out at Ellen Brook 34 km south of Dunsborough (Fig. 1). Numerous chert and quartz artifacts were exposed in the blow-out, and typological and petrological aspects of the assemblage suggest that it is attributable to the early phase of industries identified in the southwest (Dortch 1977; Glover 1975; Hallam 1972).

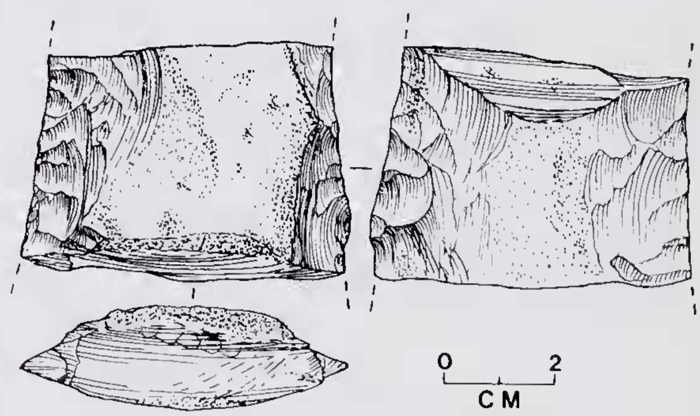

Figure 4.—The Ellen Brook biface.

The Ellen Brook biface (Fig. 4) is an invasively flaked fragment of tabular chert in which both extremities are broken off, perhaps deliberately. The piece is neatly elliptical in section, and both lateral edges are delicately flaked. The specimen is made of the distinctive Eocene bryozoan chert which as noted earlier, characterized southwestern late Pleistocene and early Holocene assemblages.

Part of the significance of the Ellen Brook biface is that, unlike the Dunsborough implement, it clearly shows that southwestern Aborigines were capable of careful, controlled invasive flaking resembling that produced by the "soft-hammer" technique (Bordes 1961, p. 8). Together the Ellen Brook and Dunsborough bifaces confirm Tindale's view that large bifaces are indigenous to the southwest (Tindale 1949, p. 165). However, Tindale based his opinion on the single find of the Scaddan implement (Fig. 2), a specimen which we believe to be probably English in origin. At the same time the view that the Scaddan implement is a "typological and technological anomaly" in southwestern Australia (Dortch and Glover in press) must be amended. Thus, pieces similar to the Scaddan implement were made by southwestern Aborigines, if only rarely. The probable early Holocene or late Pleistocene ages and early-phase associations of both the Dunsborough and Ellen Brook implements suggest that other specimens resembling Old World Palaeolithic bifaces are likely to be identified in early-phase assemblages in the southwest.

This discussion should end with a note on techniques. Petrology has long been used with some success to trace the history of European and Australian artifacts, but it is not always easy to distinguish between cherts by petrology. Invertebrate fossils can be useful. Floral remains, despite their toughness, do not always survive silicification, as in the Scaddan implement. On the other hand, floral residues from the Dunsborough implement have unequivocally shown its Australian origin. Palynological examination should therefore be attempted whenever an exotic origin is suspected.

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